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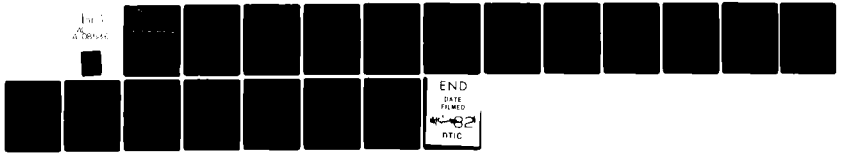

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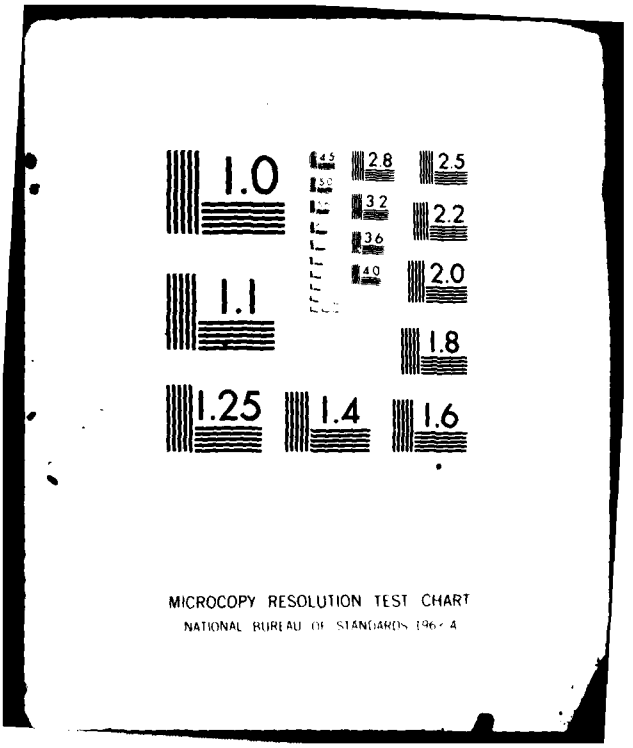
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LEVEL II

United States Army
Recruiting Command

RESEARCH MEMORANDUM 81-3 AD _____

Factors Affecting U.S. Army Recruiting

By

GERALD A. KLOPP

September 1981

Approved for Public Release;
Distribution Unlimited

Research, Studies and Evaluation Division
Program Analysis and Evaluation Directorate
Fort Sheridan, Illinois 60037

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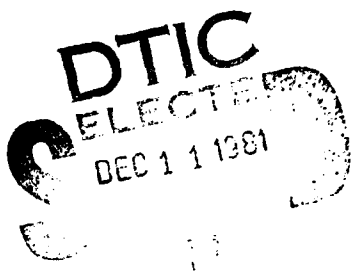

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U.S. ARMY RECRUITING COMMAND
RESEARCH, STUDIES AND EVALUATION DIVISION
PROGRAM ANALYSIS AND EVALUATION DIRECTORATE

Ft. Sheridan, IL 60037

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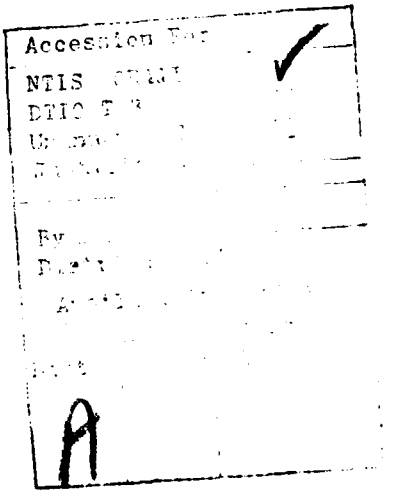
ABSTRACT

This paper compares seven models which were developed to explain the relationships between recruiting variables and the accomplishment of the recruiting mission. The evaluation considered three Army models developed by contract, two Army models developed in-house, and two Navy models. The paper discusses common problems which were found in several of the models: collinearity, homoscedasticity, and lack of sufficient statistical tests and prediction interval determination. The Army's Enlistment Prediction model (EPM) is used to illustrate the presence of collinearity. The paper concludes with some comments on the use of analysis, as well as management involvement when prediction models are used for mission assignment.



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INTRODUCTION

Army recruiting is a function of environmental variables, such as geographical area, population density, and labor force size; economic factors, such as income, unemployment, and minimum wage; time, such as monthly and seasonal variations; and systemic variables, such as advertising, the number of recruiters, and other conditions which the Army can directly influence. The Army and other services have made great strides in defining the marketplace and the relationships of the variables to the recruiting mission. The Army Recruiting Command (USAREC) currently uses a combination of automated methods (including a prediction model), professional judgement, and institutional memory to distribute the recruiting mission to its five Region Recruiting Commands (RRC's) and its fifty-six District Recruiting Commands (DRC's). The starting point of the mission assignment is the use of the Enlistment Production Model (EPM), a regression analysis model which produces thirteen accession "mission boxes" and seventeen contract "mission boxes" per DRC and RRC per quarter using variables which have shown a high degree of correlation to historic mission accomplishment.

After the model's missions are generated, the projections of market recruit potential are converted to percentages of the command and region missions. Thus, when Department of the Army assigns the command a mission, the DRC mission can be determined by multiplying the percentages by the command mission. After the recruit potential percentages are determined, professional judgement and intuition are used by the Program Analysis and Evaluation (PA&E) Directorate personnel to refine the mission. Finally, negotiations (called mission adjudication) between the Commander, USAREC and DRC commanders further alter and revise the individual missions. Thus, the model serves only as a starting point in mission allocation. However, because adjudication takes place quarterly for each DRC and individual contract and accession mission box elements, only some boxes are contested and others remain essentially as the model specifies.

PROBLEM

Emerging research on the relationships between the various variables and the recruiting mission (see list of references) has not been adequately integrated to provide management with resource allocation models. For example, the EMP should indicate the proper allocation of recruiters, advertising dollars, recruiter aides, etc. on the basis of placing each resource where it will be most productive. It should also provide means to evaluate different resource allocation scenarios. Because of growing needs to justify resource requirements to the Headquarters of the Army, the Department of Defense, the Office of Management and Budget, and the Congress, USAREC needs a clear, rational process, to analyze the impacts of resource and environmental or economic variable changes on its mission to recruit qualified individuals.

RECRUITING RESOURCE ANALYSIS

Prior to initiating an effort to design and develop a recruiting resource allocation model, an evaluation of available models was conducted. This evalulation considered the following three models developed by contract: N. W. Ayer Advertising Effectiveness Model (1)*, Optimal Recruiter Allocation Model (ORAM) (2), and Claritas Geodemographic Model (7); two models developed in-house: Veteran's Educational Assistance Program (VEAP) Incentives Model (3) and Enlistment Projection Model; and two models developed for the Navy: Morey's Budget Allocation and Enlistment Prediction Model (5) and Goldberg's Navy Enlisted Supply Study (4). The purpose of this evaluation was to identify the areas of commonality of the models, to determine their strengths and weaknesses which may effect future model building, and to determine how well existing models explain the relationship of recruiting variables to and accomplishment of the recruiting mission.

As shown below, the models use several types of dependent variables:

Accessions
Contracts > By Mental Category
Exams
Others

- Leads
- Term of Enlistment
- Recruit Potential Indicies
- Recruiter and Advertising Allocation

As indicated in table 1, many of the models predict accessions. However, as Cirie (10) indicates in his review of Navy models, models might do better if they predict contracts instead of accessions, thus removing the lag effects encountered when the actual recruit enters the Delayed Entry Program (DEP) and the uncertainty of the time of the actual accession. The N. W. Ayer model attempts to address this problem by estimating exams by mental category and using a linkage model to predict accessions. This linkage model accounts for DEP losses, but still has the problem of accounting for the time of actual accession.

It should be pointed out that each model was developed for a specific purpose. For example, the EPM was developed to assign missions down to the DRC level by various categories such as accession, contracts, prior service, mental category, etc. The ORAM model was also designed to show the relationship between variables and the DRC mission, but it cannot break out the mission by mental category. The VEAP Model was intended to show the effects of bonuses and educational incentives on contracts. These models also take different forms and result in differing ability to accurately predict the dependent variable. This is summarized in table 2. Even though most of the models use regression analysis, different forms of regression (additive or multiplicative) are used, with different data for different periods. A general criticism of all models is that, validation has centered mostly on historical accuracy (e.g. r square values), and little consideration is given to predictive ability. This could stem, in part, from the inability to make forecasts of future values, e.g. unemployment. As shown in table 3, several of the models need accurate forecast methods to predict the dependent variable.

* Numbers in parentheses denote the reference number in the list of references.

Table 1: List of dependent Variables

VARIABLE:	N.N. AYER		ORAM	VEAP	LIM	MOREY		GOLDBERG	CLARITAS
	SUPPLY	LINKAGE				SUPPLY	BUDGET		
ACCESSIONS:									
MALE(1-3A)		Y	Y		Y				
MALE(3B-4)		Y	Y						
NPS(F)					Y				
NPS(M)					Y				
HSDG(M)		Y			Y	Y			
NHSDG(1-3A)		Y							
ANY		Y							
CONTRACTS:								Y	
HSG(M)				Y(1-3A ONLY)				Y	
HSG(W M)								Y	
HSG(1-3A M)								Y	
HSG(1-3A W M)								Y	
HSG(1-2M)								Y	
HSG(1-2 W M)						Y			
TOTAL									
EXAMS:									
1-3A	Y	X							
3B-4	Y	X							
OTHER:									
LEADS						Y			
ENLIST TERM				BONUS AMOUNT *					Y
RECRUIT POTENTIAL							Y		
RECRUITER DISTRIBUTION							Y		
ADVERTISING DISTRIBUTION									

NOTES: Y DENOTES DEPENDENT VARIABLE
X DENOTES INDEPENDENT VARIABLE

* TERM OF ENLISTMENT DISTRIBUTION (IN YEARS) HIGHLY RELATED TO BONUS AMOUNT.

Table 2: Model Comparison

	MOREY (NAVY)		GOLDBERG (NAVY)	CLARITAS
	PREDICTION MODEL	BUDGET ALLOCATION		
R Squared			VARIES FROM .56 TO .78	.65
DATA PERIODS	MONTHLY	MONTHLY	YEARLY	MONTHLY
MODEL TYPE	MULTIPLICATIVE	NON-LINEAR PROGRAMMING	MULTIPLICATIVE	LINEAR REGRESSION
LEVEL	REGION (CAN BE DRC)	REGION (CAN BE DRC)	COMMAND	ZIP CODE
TIME	1976-1977	1976-1977	1976T-1980	1977-1978
OUTPUT	ENLISTMENTS 1ST STEP CONTRACTS 2ND STEP	RECRUITER AND ADVERTISING REQUIREMENTS	ENLISTMENTS	RECRUIT POTENTIAL AND UNTAPPED POTENTIAL
COMMENTS	FIRST STEP PREDICTS ENLISTMENTS BY CATEGORY. ON SECOND STEP, CONTRACTS=P(LAGGED RECRUITERS)(LAGGED ADVERTISING). THE P MATRIX IS SOLVED FOR AND IS USED IN THE BUDGET ALLOCATION MODEL SINCE IT CONTAINS THE INTERACTION OF RECRUITERS AND ADVERTISING AND THEIR CONTRIBUTION TO CONTRACTS.	OPTIMAL ADVERTISING AND RECRUITER MIX. USES P MATRIX OF 2ND STEP OF ENLISTMENT PREDICTION MODEL. WEIGHTED OBJECTIVE FUNCTION VARIABLES, DEPENDING ON PENALTY FOR NOT MEETING OBJECTIVES. CAN ALSO CONSTRAIN BUDGET. CONTAINS INITIAL CONDITIONS, DEP FLOW, TERMINAL CONDITIONS, AND TIME FLOW CONSIDERATIONS.	INCLUDES ALL SERVICES RECRUITERS. DATA ACCOUNTS FOR LOSSES IN DEP AND RENORMING OF ASVAB. DATA NOT AVAILABLE AND COST ANALYSIS NOT SHOWN TO VERIFY RESULTS.	USES FACTOR ANALYSIS ON 535 VARIABLES TO PRODUCE 34 FACTOR SCORES FOR EACH ZIP CODE. FACTOR SCORES ARE GROUPED BY CLUSTER ANALYSIS INTO 40 NEIGHBORHOOD TYPES (CLUSTERS). USING 34 FACTOR SCORES AND OTHER SYSTEMIC AND ENVIRONMENTAL VARIABLES, 7 SUB-AREAS WERE FOUND BY CLUSTERING. RECRUIT PENETRATION FOR 7 SUB-AREAS WERE FOUND BY REGRESSION. UNTAPPED POTENTIAL = PREDICTED MINUS ACTUAL (0 IF NEGATIVE).

Table 2 (continued): Model Comparison

	N.N. AYER		ORAM	VEAP	ENLISTMENT PREDICTION MODEL (EPM)
	FIRST STAGE	LINKAGE			
R Squared	.93	.88	.999	N/A	.69 (COMMAND ONLY)
DATA PERIODS	MONTHLY	MONTHLY	YEARLY	AVERAGE OF MONTHLY	QUARTERLY
MODEL TYPE	LINEAR ADDITIVE	MULTIPLICATIVE	MULTIPLICATIVE	SIMULTANEOUS EQUATIONS	LINEAR ADDITIVE
LEVEL	COMMAND	COMMAND	DRC	COMMAND	DRC
TIME	1976-1980	1976-1980		FY 80 and 81	FY77-CURRENT (SOME 74)
OUTPUT	EXAMS BY CATEGORY	ACCESSIONS BY CATEGORY	ACCESSIONS BY MENTAL CATEGORY	ACCESSIONS OF MENTAL CATEGORY I-IIIA	MISSION MATRIX BOX & % COMMAND MISSION
COMMENTS	TWO STAGE ACCESSION MODEL OF HIGH QUALITY MARKET.		PART OF A SERIES OF MODELS CALLED ANALYSIS FOR MANAGEMENT OF RECRUITING RESOURCE AND OPERATIONS (AMRRO). AMRRO ALSO HAS BAM (BUDGET ALLOCATION MODEL) WHICH CAN BE USED WITH ORAM IN ITERATIVE WAY FOR ADVERTISING AND RECRUITER ALLOCATION (PRODUCES INDEPENDENT ESTIMATES WHICH MAY NOT BE JOINTLY OPTIMAL)	CONTAINS FOUR RATIO FACTORS (VARIABLE EXPONENTS) FOR EACH OF FOUR VEAP TEST CELLS. THE FOUR VARIABLES ARE SOLVED SIMULTANEOUSLY TO GIVE THE CONTRIBUTIONS OF THE FOUR TEST CONDITIONS TO HIGH QUALITY ACCESSIONS. PROJECTIONS TO NATIONAL VEAP OPTIONS ARE MADE BASED ON THE FOUR EQUATIONS AND FOUR VARIABLES.	NEXT FOUR QUARTER PROJECTIONS ARE MADE FOR VARIOUS VARIABLES (E.G. *UNEMPLOYMENT*). REGRESSION EQUATIONS COMPUTED USING PAST DATA. DRC PROJECTION (X). PROJECTIONS MODIFIED BY AVERAGE OF PAST PRODUCTION (A) FOR QUARTER AND LAST NONZERO PAST PRODUCTION (L); IF $X \leq A$, POTENTIAL=$(A+L)/2$ $X > A$, POTENTIAL=MIN(X, 1.3L) REGION AND DRC % SHARE OF MARKET CALCULATED AND APPLIED TO USAREC MISSION TO DETERMINE DRC ACCESSION AND CONTRACT MISSION.

Table 3: List of Explanatory Variables

EXPLANATORY VARIABLES	N.W. AYER SUPPLY	N.W. AYER LINKAGE	ORAM	VIAP	IJM	MOREY SUPPLY HEIGHT	GOLDBERG	CLARITAS
ENVIRONMENTAL								
AREA								
BLACK MALE POPULATION					X			535 VARIABLES, 34
HIGH SCHOOL SENIORS					X		2 0 3 0 2 0	IN 5 DOMAINS:
LABOR FORCE					X			ED & AFFLUENCE
POPULATION DENSITY						X(DENOMINATOR)		FAMILY LIFE
PROPENSITY			3 2					HOUSING & URBANIZATION
QMA					X			ETHNICITY
WHITE POPULATION					X		0 5 4 4 3	MOBILITY
ECONOMIC FACTORS								
BONUSES								
CETA COUNTERCYCLICAL				X (TERM ENLIST)				SEE COMMENTS ABOVE
CETA YOUTH							0 0 0 0 8 9	
GI BILL	1 1	X					4 4 0 6 0 7	
INCENTIVES						X(INDICATOR)	0 0 2 2 3 2	
INCOME				AVG 80/AVG 81				
RELATIVE PAY	4 7		3		X			
UNEMPLOYMENT	2 5		4	AVG 80/AVG 81	X		1 1 1 1 1 1	
							(NOT SIGNIFICANT)	
TIME								
PERIODS								
JANUARY	3 4				X(QUARTERLY)	X(LAG INDICATOR)		
SEP-OCT	4 8							
SYSTEMIC								
ARMY ADVANTAGE								
ADVERTISING				0 if 80=81 or -1				
LOCAL								
NATIONAL					X(BY DRC LAGGED)			
LONG-TERM	9		1 1			X X		
SHORT-TERM	7 3							
ATTRITION								
DEP						X		
RECRUITERS						X		
ARMY								
NAVY	8 6		2 5	AVG 80/AVG 81	X(ALSO ARMY/DOD $)		0 3 7 3 7 5	X
MARINES						X X	3 2 0 8 0 8	
AIR FORCE							0 0 5 7 5 6	
RECRUITER AIDES							0 6 6 5 6 4	
RECRUITER OBJECTIVES					X			
BY PERIOD	4 2							
LONG-TERM		X				X		
SHORT-TERM		X						
RECRUITER EXPERIENCE								
LEADS					X			
REGION COMMAND					X(REACT LEADS)	X		
RECRUIT CONTRACT DATA					X	X		
								QUALITY, SEX, AGE, SERVICE, MOS

NUMBERS REPRESENT THE ORDER OF THE TEST STATISTIC FOR EXPLAINING VARIATION (0 MEANS NOT SIGNIFICANT AND 1 IS HIGHEST).
COLUMNS CORRESPOND TO Y VARIABLES IN TABLE 1 (I.E. FIRST COLUMN FOR 1-3A EXAMS OF N.W. AYER, SECOND FOR 3B-4EXAMS).

Some environmental variables may be influenced by many other variables. Propensity, for example, may be a function of unemployment, geographic location, time of the year, and other conditions. Other environmental variables may experience variations which are more accurately predictable. Futher study on the relationship among variables is clearly needed.

All of these models use economic variables to predict the dependent variable. Several use indicator variables to include the presence or the absence of the GI Bill. Indicator time variables are also used (sometimes lagged to account for delayed effects). Also, there is a heavy reliance on systemic variables, the variables which are most easily influenced and therefore forecasted. Although there is good reason to use many of these variables, usefulness sometimes tends to replace validity as the criterion of inclusion, and that cause and effect are not always present in systemic variables. For example, in the mission projection of EPM, consideration is given to past production history. If the projection calls for a mission which exceeds past production, the mission starting point for the DRC is set no higher than 130 percent of the past production. Alternatively, if the mission assigned is lower than past production, the mission starting point is the same as the past production. Thus, the model adjusts slowly to market conditions. Accordingly, using recruiter objectives as an independent variable does not really capture a cause and effect relationship to contracts or accessions per se. It may, however, capture command limitations or changing objectives in difficult recruiting areas. This lack of true variation in the independent variable is reflected in lack of true predictability of the dependent variable. The the lack of variation in systemic variables also exists in advertising, recruiters, DEP counts, etc.

Evalulation of Regression Models

While investigating the relationships of the models to each other, the following common problems in the models were found: collinearity, homoscedasticity, and lack of sufficient statistical tests and prediction interval determination. The comments which follow are based upon an analysis of the data from the EPM and N. Y. Ayer model. Similar problems in the Navy models were also found (see the findings in reference 10).

The relationship between various independent variables (commonly called collinearity) can be illustrated by the correlation analysis of data from the EPM model shown in table 4:

Table 4: Correlations of Selected Independent Variables

	Advertising	QMA	Aides	DOD Recruiters	Army Recruiters
Army Recruiters	.623(2)*	.9			
QMA	.7				
1st Quarter(Dummy)	-.51 (8)		.69 (9)		
2nd Quarter(Dummy)	.6				
DOD Recruiters	.56 (11)	.81			.81(11)
High School Seniors	.57 (3)				.86 (3)

*Numbers in parentheses show the step in which both variables were present in the command regression equation, using the stepwise regression method (see reference 9).

Although correlations for other variables were greater than zero, only those correlations having an absolute value of .5 are shown in table 4. It can be seen that some of the highest correlated variables enter into the model at the early steps in model building. This collinearity results in inaccurate models of the relationships of the independent variables to the dependent variable. Similar correlations exists among the variables in the N. W. Ayer model. It should be emphasized here that collinearity is not a misspecification of the model. It is, however, an inadequacy of the data. A way to overcome the data inadequacy is to collect other data which are not collinear to independent variables, or attempt to determine the relationships among the variables and include this in the regression model in place of the related variables. One way to investigate these relationships is factor analysis (8,9). It should also be pointed out that the correlations among the various variables in the correlation matrix includes only the first order effects. Higher order effects can be detected through the following conditions:

o If an unexpected relationship is found. For example, in Table 5, increasing the number of high school seniors has a negative effect on accessions. It may be that the correlation between the first three variables in the model causes the results to be improperly depicted.*

o If large changes in estimated coefficients occur when a new variable is added or deleted. See Table 5, which shows that, at step 8, the coefficient of advertising cost changed from .23 to .12 by adding 1st Quarter (Dummy), which is highly correlated to advertising (table 4), which entered on previous steps.

o If the determinant of the correlation matrix is small (small value means that the matrix of correlation coefficients is approaching a singular matrix).

o If the ratio of the largest eigenvalue (characteristic root) of the correlation matrix to the smallest is greater than 10. For EMP, the ratio is 48. (If there is no collinearity, the eigenvalues all would be equal to 1.0).

o If the sum of the reciprocals of the eigenvalues is greater that 5 times the number of variables. For EMP, this sum equals 40, which is less than 5 times 12 variables.

o If any eigenvalue is less than 0.1. For EPM, the smallest eigenvalue is .08.

* When two variables are correlated, the regression coefficients will take on values with opposite signs (one positive and the other negative). As the correlation between the variables increases to one, the regression coefficients for these variables gets closer in absolute value but with opposite sign, regardless of the true individual effects.

Table 5. Coefficients of entering variables in EPM, for the command quarterly high school degree graduate male accession.

	Step											
Variables	1	2	3	4	5	6	7	8	9	10	11	12
USA Rects	1.5	1.2	1.8	1.8	1.8	1.8	1.8	1.8	1.6	1.7	1.6	1.5
Adv. Cost		.21	.23	.23	.23	.24	.23	.12	.15	.15	.14	.12
High School Seniors			-.19	-.19	-.15	-.16	-.12	-.11	-.08	-.09	-.11	-.11
SW (Dummy)				-25	-29	-26	-26	-27	-25	-28	-29	-27
Income					-42	-49	-48	-50	-43	-41	-41	-44
Blacks						-3.8	-3.8	-3.7	-4.2	-4.7	-5.1	-5.0
3rd Quarter (Dummy)							-13	-19	-25	-28	-28	-28
1st Quarter (Dummy)								-18	-35	-34	-35	-34
Aides									.47	.52	.54	.49
Recruiter Experience										.53	.56	.68
DOD Recruiter											.13	.19
MW (Dummy)												.10
R Squared	.52	.56	.57	.61	.64	.66	.67	.67	.68	.69	.69	.69

Table 6. Cofficients in EPM Regression Model

Variable	Ratio of Coefficients in Step 12 to Step Variable Entered
USA Recruiters	1.0
Advertising Cost	.57
High School Seniors	.58
SW (Dummy)	1.08
Income	1.25
Blacks	1.0
3rd Quarter (Dummy)	2.15
1st Quarter (Dummy)	1.88
Aides	1.04
Recruiter Experience	1.45
DOD Recruiters	1.45
MW (Dummy)	1.0

It can be seen from table 6 that the collinearity problem causes the model to depict different relationships between the independent variables and the dependent variable after new variables are added. Also, the indication is that time plays an important relationship in forecasting recruit potential. However, because of the multicollinearity, the exact relationship cannot be determined from this model.

Most of the models use lag variables to determine the effects of time. However, autocorrelation is seldom addressed. N. W. Ayer reports on tests which show a minimum acceptable autocorrelation present in the exams generating model, but fails to adequately address autocorrelation in the linkage model or its effect on

forecasts. Tests on model assumptions are also generally lacking. An inspection of the EPM shows that the variance of the residuals increase with predicted value, an indication of homescedasticity (error term has error variance that is not a constant). Thus, not only is the data set deficient (collinearity), the model is not specified correctly. The most obvious difference in the various models is that the data covers different time periods, varies in quantity, and varies in type of data. There is some question as to the validity of using indicator variables for one time events, e.g. GI Bill. There seems to be no problem with using indicator variables with repeated events e. g. monthly variation. Most of the models also suffer from the degrees of freedom problem. That is, the number of observations minus the number of estimated parameters (independent variables) is low. This is a problem of insufficient data which can be eased as more data becomes available. However, this too will create a problem in that the new data may not be gathered over the same set of conditions that the old data was gathered over.

EVALUATION (OF OTHER THAN REGRESSION MODELS)

The Claritas and VEAP models have not been fully developed and their methodology has not been published. Accordingly, a more thorough analysis and comparison with other models is not possible. However, a few comments can be offered.

First, the VEAP model uses unemployment and recruiters (FY80 and FY81) as two of its four explanatory variables. This use is consistent with the other models which found these to be good predictors of the dependent variables. The use of four simultaneous equations (one for each of four test or alternative VEAP conditions) is needed because of the limited data on VEAP contracts. As more data becomes available, it is expected that a regression model will be developed to incorporate bonuses and incentives, as well as the explanatory variables used in other models. It is interesting to note that the data suggest that bonuses predict the term of enlistment distribution (2, 3, or 4 years) while the education incentive option predicts the number of contracts. In order to develop a complete cost model, however, consideration for those who enlist for an option and those who actually use the option must be made.

The Claritas model uses several techniques to arrive at a prediction of recruit potential. The basic methodology begins with over 500 demographic variables which are simplified into 34 factors using Factor Analysis (see references 8 and 9). The 34 factors are evaluated at the Zip Code level. The model builders argue that current (regression) models use past production data of questionable accuracy (unemployment), and cannot specify mission with accuracy below the DRC (7).

Using the 34 factors, measures of recruiter strength, and the proportions of Zip population enrolled in college and serving in the Armed Forces (past production data of questionable accuracy?), a linear regression model was developed with the annual recruit penetration into the available population of males in a specified age group as the dependent variable The data apparently were clustered into seven sub-areas. Also, a method which Claritas calls a "better half" technique uses only the above average data (reduces variation, resulting in a better r squared). Again, it would appear that the model builders were too concerned with usefulness and not with future predictability.

It would appear that the model has inaccuracies because of its inability to consider (forcast) changes in certain variables which include unemployment, recruiter strength, advertising, and recruiter experience. The previous discussion on the models addressed these variables. Also, the CLARITAS methodology gives no indication of the source or degree of statistical inaccuracy. Statistical tests may not have been done. These tests should include an evaluation of the contribution of the 34 factors and other variables to the model's prediction ability. The model may also have data deficiencies since the 535 geomographic variables which were used to make up the 34 factors use 1970 census data. However, Claritas argues that the clusters which it has identified are rather homogeneous and that any migration out of a cluster will be filled by a similar group migrating into a cluster.

THE ROLE OF MANAGEMENT IN MODEL USE

While the previous discussion has focused primarily on the EPM, it is important to restate an observation: similar problems in other models have been found. These problems should not lead one to discard all models entirely. They should, however, lead one to conclude that more research and better techniques are required if the models are to effectively be integrated into the decision making process. In defense of the EPM, the following should be considered:

a. The EPM generated mission matrix boxes are only initial starting values. The computer does not assign mission, people assign mission. Thus, the adjudication process, the use of intuition and professional judgement, and the heuristic evaluation of projected mission requirements vs past production is justified in light of the technical difficulties of the model.

b. The model shows a good abililty to explain past production as evidenced by the r square values (which are improved when specific DRC missions are determined as opposed to the over-all command r square). The values of the dependent variable do not change substantially from the present to the next few quarters. Accordingly, even though the exact relationship of each individual independent variable to each other and to the dependent variable is not known, the aggregate relationship to the dependent variable is predictable with a good degree of accuracy.

c. Even if a model could be developed which would solve the model deficiencies, optimal model solutions should not be used as a sole criteria for mission assignment and resource allocaction. For example, the ORAM (2) model indicates that the optimal allocation of recruiters would move some recruiters for the Northern and Western RRC's and place the recruiters in the two southern RRC's (primarily SE RRC). This optimal allocation is based upon past performance which has been observed to effect recruiting. The models would continue to place more recruiters where past recruiting has been successful. Use of the model exclusively would prevent innovative management and other techniques from affecting the recruiting goals.

d. Growing experience and data suggest that management initiatives can and must be used to improve recruiting. For example, the N.W. Ayer report shows that simply increasing the recruit mission results in increasing the number of lower mental category accessions at the expense of the quality (higher mental category) accession. Current mission assignments are intended to eliminate the practice of going after the easy market by placing specific requirements for high school graduates and high mental ability individuals. In view of the projected budget requirements of ORAM, N.W. Ayer, and other models, massive resources will be needed to meet mission requirements. Clearly, obtaining less than optimal resources will require continuing very strong management inititives.

SUMMARY AND CONCLUSION

Models of recruiting vary in form, data used, and complexity. They require continued evolutionary development to detect relationships among the various parts of the models. This will be accomplished as new data are gathered and more sophisticated methodologies used.

Future work on modeling for the Army will concentrate on validation of the predictions and on statistical tests of significance. Contract work will include building (and purification) of data bases, as well as building a time series cross sectional recruiting resource allocation model, which will assist analysts and decision making to determine the resources and time needed to achieve recruiting objectives, by amount, type, mix.

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This paper compares seven models which were developed to explain the relationship between recruiting variables and the accomplishment of the recruiting mission. The evaluation considered three Army models developed by contract, two Army models developed in-house, and two Navy models. The paper discusses common problems which were found in several of the models: collinearity, homoscedasticity, and lack of sufficient statistical tests and prediction interval determination. The Army's Enlistment Prediction Model (EPM) is used to illustrate the presence of collinearity. The paper concludes with some comments on

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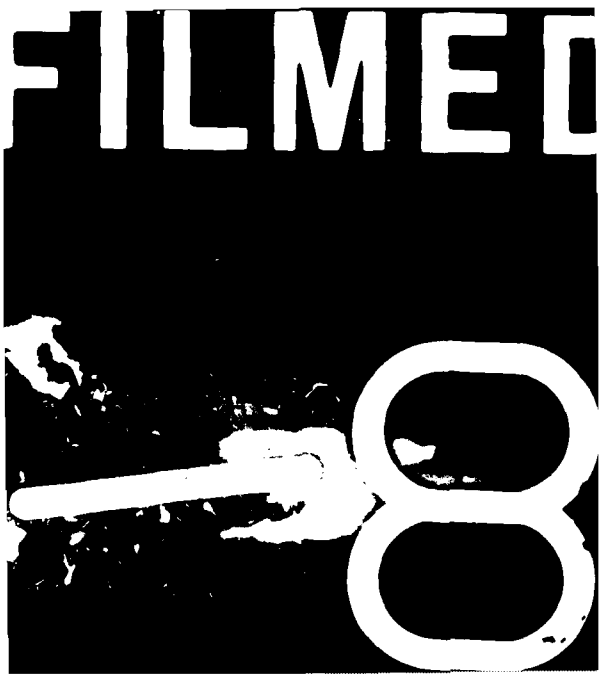
Abstract continuation

the use of analysis as well as management involvement when prediction models are used for mission assignment.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